NAME

aio_cancel — cancel an asynchronous I/O request (**REALTIME**)

SYNOPSIS

AIO
```
#include <aio.h>

int aio_cancel(int fildes, struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_cancel*( ) function shall attempt to cancel one or more asynchronous I/O requests currently outstanding against file descriptor *fildes*. The *aiocbp* argument points to the asynchronous I/O control block for a particular request to be canceled. If *aiocbp* is NULL, then all outstanding cancelable asynchronous I/O requests against *fildes* shall be canceled.

Normal asynchronous notification shall occur for asynchronous I/O operations that are successfully canceled. If there are requests that cannot be canceled, then the normal asynchronous completion process shall take place for those requests when they are completed.

For requested operations that are successfully canceled, the associated error status shall be set to [ECANCELED] and the return status shall be –1. For requested operations that are not successfully canceled, the *aiocbp* shall not be modified by *aio_cancel*( ).

If *aiocbp* is not NULL, then if *fildes* does not have the same value as the file descriptor with which the asynchronous operation was initiated, unspecified results occur.

Which operations are cancelable is implementation-defined.

RETURN VALUE

The *aio_cancel*( ) function shall return the value AIO_CANCELED if the requested operation(s) were canceled. The value AIO_NOTCANCELED shall be returned if at least one of the requested operation(s) cannot be canceled because it is in progress. In this case, the state of the other operations, if any, referenced in the call to *aio_cancel*( ) is not indicated by the return value of *aio_cancel*( ). The application may determine the state of affairs for these operations by using *aio_error*( ). The value AIO_ALLDONE is returned if all of the operations have already completed. Otherwise, the function shall return –1 and set *errno* to indicate the error. 2

ERRORS

The *aio_cancel*( ) function shall fail if:

[EBADF] The *fildes* argument is not a valid file descriptor.

EXAMPLES

None.

APPLICATION USAGE

The *aio_cancel*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_read( ), *aio_write*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/10 is applied, removing the words ‘‘to the calling process’’ in the RETURN VALUE section. The term was unnecessary and precluded threads. 2

NAME

aio_error — retrieve errors status for an asynchronous I/O operation (**REALTIME**)

SYNOPSIS

AIO
```
#include <aio.h>

int aio_error(const struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_error*( ) function shall return the error status associated with the **aiocb** structure referenced by the *aiocbp* argument. The error status for an asynchronous I/O operation is the SIO *errno* value that would be set by the corresponding *read*( ), *write*( ), *fdatasync*( ), or *fsync*( ) operation. If the operation has not yet completed, then the error status shall be equal to [EINPROGRESS].

RETURN VALUE

If the asynchronous I/O operation has completed successfully, then 0 shall be returned. If the asynchronous operation has completed unsuccessfully, then the error status, as described for SIO *read*( ), *write*( ), *fdatasync*( ), and *fsync*( ), shall be returned. If the asynchronous I/O operation has not yet completed, then [EINPROGRESS] shall be returned.

ERRORS

The *aio_error*( ) function may fail if:

[EINVAL] The *aiocbp* argument does not refer to an asynchronous operation whose return status has not yet been retrieved.

EXAMPLES

None.

APPLICATION USAGE

The *aio_error*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_cancel( ), *aio_fsync*( ), *aio_read*( ), *aio_return*( ), *aio_write*( ), *close*( ), *exec*, *exit*( ), *fork*( ), *lio_listio*( ), *lseek*( ), *read*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

NAME

aio_fsync — asynchronous file synchronization (**REALTIME**)

SYNOPSIS

AIO

```
#include <aio.h>

int aio_fsync(int op, struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_fsync*( ) function shall asynchronously force all I/O operations associated with the file indicated by the file descriptor *aio_fildes* member of the **aiocb** structure referenced by the *aiocbp* argument and queued at the time of the call to *aio_fsync*( ) to the synchronized I/O completion state. The function call shall return when the synchronization request has been initiated or queued to the file or device (even when the data cannot be synchronized immediately).

If *op* is O_DSYNC, all currently queued I/O operations shall be completed as if by a call to *fdatasync*( ); that is, as defined for synchronized I/O data integrity completion. If *op* is O_SYNC, all currently queued I/O operations shall be completed as if by a call to *fsync*( ); that is, as defined for synchronized I/O file integrity completion. If the *aio_fsync*( ) function fails, or if the operation queued by *aio_fsync*( ) fails, then, as for *fsync*( ) and *fdatasync*( ), outstanding I/O operations are not guaranteed to have been completed.

If *aio_fsync*( ) succeeds, then it is only the I/O that was queued at the time of the call to *aio_fsync*( ) that is guaranteed to be forced to the relevant completion state. The completion of subsequent I/O on the file descriptor is not guaranteed to be completed in a synchronized fashion.

The *aiocbp* argument refers to an asynchronous I/O control block. The *aiocbp* value may be used as an argument to *aio_error*( ) and *aio_return*( ) in order to determine the error status and return status, respectively, of the asynchronous operation while it is proceeding. When the request is queued, the error status for the operation is [EINPROGRESS]. When all data has been successfully transferred, the error status shall be reset to reflect the success or failure of the operation. If the operation does not complete successfully, the error status for the operation shall be set to indicate the error. The *aio_sigevent* member determines the asynchronous notification to occur as specified in Section 2.4.1 (on page 28) when all operations have achieved synchronized I/O completion. All other members of the structure referenced by *aiocbp* are ignored. If the control block referenced by *aiocbp* becomes an illegal address prior to asynchronous I/O completion, then the behavior is undefined.

If the *aio_fsync*( ) function fails or *aiocbp* indicates an error condition, data is not guaranteed to have been successfully transferred.

RETURN VALUE

The *aio_fsync*( ) function shall return the value 0 if the I/O operation is successfully queued; otherwise, the function shall return the value –1 and set *errno* to indicate the error. 2

ERRORS

The *aio_fsync*( ) function shall fail if:

[EAGAIN] The requested asynchronous operation was not queued due to temporary resource limitations.

[EBADF] The *aio_fildes* member of the **aiocb** structure referenced by the *aiocbp* argument is not a valid file descriptor open for writing.

[EINVAL] This implementation does not support synchronized I/O for this file.

[EINVAL] A value of *op* other than O_DSYNC or O_SYNC was specified.

In the event that any of the queued I/O operations fail, *aio_fsync*() shall return the error condition defined for *read*() and *write*(). The error is returned in the error status for the asynchronous *fsync*() operation, which can be retrieved using *aio_error*().

EXAMPLES

None.

APPLICATION USAGE

The *aio_fsync*() function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

fcntl(), *fdatasync*(), *fsync*(), *open*(), *read*(), *write*(), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/11 is applied, removing the words ‘‘to the calling process’’ in the RETURN VALUE section. The term was unnecessary and precluded threads. 2 2 2

NAME

aio_read — asynchronous read from a file (**REALTIME**)

SYNOPSIS

AIO
```
#include <aio.h>

int aio_read(struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_read*( ) function shall read *aiocbp->aio_nbytes* from the file associated with *aiocbp->aio_fildes* into the buffer pointed to by *aiocbp->aio_buf*. The function call shall return when the read request has been initiated or queued to the file or device (even when the data cannot be delivered immediately).

PIO If prioritized I/O is supported for this file, then the asynchronous operation shall be submitted at a priority equal to a base scheduling priority minus *aiocbp->aio_reqprio*. If Thread Execution Scheduling is not supported, then the base scheduling priority is that of the calling process; otherwise, the base scheduling priority is that of the calling thread. 2

The *aiocbp* value may be used as an argument to *aio_error*( ) and *aio_return*( ) in order to determine the error status and return status, respectively, of the asynchronous operation while it is proceeding. If an error condition is encountered during queuing, the function call shall return without having initiated or queued the request. The requested operation takes place at the absolute position in the file as given by *aio_offset*, as if *lseek*( ) were called immediately prior to the operation with an *offset* equal to *aio_offset* and a *whence* equal to SEEK_SET. After a successful call to enqueue an asynchronous I/O operation, the value of the file offset for the file is unspecified.

The *aiocbp->aio_lio_opcode* field shall be ignored by *aio_read*( ).

The *aiocbp* argument points to an **aiocb** structure. If the buffer pointed to by *aiocbp->aio_buf* or the control block pointed to by *aiocbp* becomes an illegal address prior to asynchronous I/O completion, then the behavior is undefined.

Simultaneous asynchronous operations using the same *aiocbp* produce undefined results.

SIO If synchronized I/O is enabled on the file associated with *aiocbp->aio_fildes*, the behavior of this function shall be according to the definitions of synchronized I/O data integrity completion and synchronized I/O file integrity completion.

For any system action that changes the process memory space while an asynchronous I/O is outstanding to the address range being changed, the result of that action is undefined.

For regular files, no data transfer shall occur past the offset maximum established in the open file description associated with *aiocbp->aio_fildes*.

RETURN VALUE

The *aio_read*( ) function shall return the value zero if the I/O operation is successfully queued; otherwise, the function shall return the value –1 and set *errno* to indicate the error. 2

ERRORS

The *aio_read*( ) function shall fail if:

[EAGAIN] The requested asynchronous I/O operation was not queued due to system resource limitations.

Each of the following conditions may be detected synchronously at the time of the call to *aio_read*( ), or asynchronously. If any of the conditions below are detected synchronously, the *aio_read*( ) function shall return –1 and set *errno* to the corresponding value. If any of the

conditions below are detected asynchronously, the return status of the asynchronous operation is set to –1, and the error status of the asynchronous operation is set to the corresponding value.

[EBADF] The *aiocbp->aio_fildes* argument is not a valid file descriptor open for reading.

[EINVAL] The file offset value implied by *aiocbp->aio_offset* would be invalid, 2
PIO *aiocbp->aio_reqprio* is not a valid value, or *aiocbp->aio_nbytes* is an invalid 2
value. 2

In the case that the *aio_read*( ) successfully queues the I/O operation but the operation is subsequently canceled or encounters an error, the return status of the asynchronous operation is one of the values normally returned by the *read*( ) function call. In addition, the error status of the asynchronous operation is set to one of the error statuses normally set by the *read*( ) function call, or one of the following values:

[EBADF] The *aiocbp->aio_fildes* argument is not a valid file descriptor open for reading.

[ECANCELED] The requested I/O was canceled before the I/O completed due to an explicit *aio_cancel*( ) request.

[EINVAL] The file offset value implied by *aiocbp->aio_offset* would be invalid.

The following condition may be detected synchronously or asynchronously:

[EOVERFLOW] The file is a regular file, *aiobcp->aio_nbytes* is greater than 0, and the starting offset in *aiobcp->aio_offset* is before the end-of-file and is at or beyond the offset maximum in the open file description associated with *aiocbp->aio_fildes*.

EXAMPLES

None.

APPLICATION USAGE

The *aio_read*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_cancel( ), *aio_error*( ), *lio_listio*( ), *aio_return*( ), *aio_write*( ), *close*( ), *exec*, *exit*( ), *fork*( ), *lseek*( ), *read*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Large File Summit extensions are added.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

The following new requirements on POSIX implementations derive from alignment with the Single UNIX Specification:

- In the DESCRIPTION, text is added to indicate setting of the offset maximum in the open file description. This change is to support large files.
- In the ERRORS section, the [EOVERFLOW] condition is added. This change is to support large files.

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/12 is applied, rewording the DESCRIPTION when prioritized I/O is supported to account for threads, and removing the words ‘‘to the calling process’’ in the RETURN VALUE section. 2

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/13 is applied, updating the [EINVAL] error, so that detection of an [EINVAL] error for an invalid value of *aiocbp->aio_reqprio* is only required if the Prioritized Input and Output option is supported. 2

NAME

aio_return — retrieve return status of an asynchronous I/O operation (**REALTIME**)

SYNOPSIS

AIO

```
#include <aio.h>

ssize_t aio_return(struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_return*( ) function shall return the return status associated with the **aiocb** structure referenced by the *aiocbp* argument. The return status for an asynchronous I/O operation is the value that would be returned by the corresponding *read*( ), *write*( ), or *fsync*( ) function call. If the error status for the operation is equal to [EINPROGRESS], then the return status for the operation is undefined. The *aio_return*( ) function may be called exactly once to retrieve the return status of a given asynchronous operation; thereafter, if the same **aiocb** structure is used in a call to *aio_return*( ) or *aio_error*( ), an error may be returned. When the **aiocb** structure referred to by *aiocbp* is used to submit another asynchronous operation, then *aio_return*( ) may be successfully used to retrieve the return status of that operation.

RETURN VALUE

If the asynchronous I/O operation has completed, then the return status, as described for *read*( ), *write*( ), and *fsync*( ), shall be returned. If the asynchronous I/O operation has not yet completed, the results of *aio_return*( ) are undefined.

ERRORS

The *aio_return*( ) function may fail if:

[EINVAL] The *aiocbp* argument does not refer to an asynchronous operation whose return status has not yet been retrieved.

EXAMPLES

None.

APPLICATION USAGE

The *aio_return*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_cancel( ), *aio_error*( ), *aio_fsync*( ), *aio_read*( ), *aio_write*( ), *close*( ), *exec*, *exit*( ), *fork*( ), *lio_listio*( ), *lseek*( ), *read*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

The [EINVAL] error condition is made optional. This is for consistency with the DESCRIPTION.

NAME

aio_suspend — wait for an asynchronous I/O request (**REALTIME**)

SYNOPSIS

AIO

```
#include <aio.h>

int aio_suspend(const struct aiocb * const list[], int nent,
    const struct timespec *timeout);
```

DESCRIPTION

The *aio_suspend*( ) function shall suspend the calling thread until at least one of the asynchronous I/O operations referenced by the *list* argument has completed, until a signal interrupts the function, or, if *timeout* is not NULL, until the time interval specified by *timeout* has passed. If any of the **aiocb** structures in the list correspond to completed asynchronous I/O operations (that is, the error status for the operation is not equal to [EINPROGRESS]) at the time of the call, the function shall return without suspending the calling thread. The *list* argument is an array of pointers to asynchronous I/O control blocks. The *nent* argument indicates the number of elements in the array. Each **aiocb** structure pointed to has been used in initiating an asynchronous I/O request via *aio_read*( ), *aio_write*( ), or *lio_listio*( ). This array may contain NULL pointers, which are ignored. If this array contains pointers that refer to **aiocb** structures that have not been used in submitting asynchronous I/O, the effect is undefined.

If the time interval indicated in the **timespec** structure pointed to by *timeout* passes before any of the I/O operations referenced by *list* are completed, then *aio_suspend*( ) shall return with an error. MON If the Monotonic Clock option is supported, the clock that shall be used to measure this time interval shall be the CLOCK_MONOTONIC clock.

RETURN VALUE

If the *aio_suspend*( ) function returns after one or more asynchronous I/O operations have completed, the function shall return zero. Otherwise, the function shall return a value of –1 and set *errno* to indicate the error.

The application may determine which asynchronous I/O completed by scanning the associated error and return status using *aio_error*( ) and *aio_return*( ), respectively.

ERRORS

The *aio_suspend*( ) function shall fail if:

[EAGAIN] No asynchronous I/O indicated in the list referenced by *list* completed in the time interval indicated by *timeout*.

[EINTR] A signal interrupted the *aio_suspend*( ) function. Note that, since each asynchronous I/O operation may possibly provoke a signal when it completes, this error return may be caused by the completion of one (or more) of the very I/O operations being awaited.

EXAMPLES

None.

APPLICATION USAGE

The *aio_suspend*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_read( ), *aio_write*( ), *lio_listio*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

The DESCRIPTION is updated for alignment with IEEE Std 1003.1j-2000 by specifying that the CLOCK_MONOTONIC clock, if supported, is used.

NAME

aio_write — asynchronous write to a file (**REALTIME**)

SYNOPSIS

AIO
```
#include <aio.h>

int aio_write(struct aiocb *aiocbp);
```

DESCRIPTION

The *aio_write*( ) function shall write *aiocbp->aio_nbytes* to the file associated with *aiocbp->aio_fildes* from the buffer pointed to by *aiocbp->aio_buf*. The function shall return when the write request has been initiated or, at a minimum, queued to the file or device.

PIO If prioritized I/O is supported for this file, then the asynchronous operation shall be submitted at a priority equal to a base scheduling priority minus *aiocbp->aio_reqprio*. If Thread Execution Scheduling is not supported, then the base scheduling priority is that of the calling process; 2
PIO TPS otherwise, the base scheduling priority is that of the calling thread. 2

The *aiocbp* argument may be used as an argument to *aio_error*( ) and *aio_return*( ) in order to determine the error status and return status, respectively, of the asynchronous operation while it is proceeding.

The *aiocbp* argument points to an **aiocb** structure. If the buffer pointed to by *aiocbp->aio_buf* or the control block pointed to by *aiocbp* becomes an illegal address prior to asynchronous I/O completion, then the behavior is undefined.

If O_APPEND is not set for the file descriptor *aio_fildes*, then the requested operation shall take place at the absolute position in the file as given by *aio_offset*, as if *lseek*( ) were called immediately prior to the operation with an *offset* equal to *aio_offset* and a *whence* equal to SEEK_SET. If O_APPEND is set for the file descriptor, write operations append to the file in the same order as the calls were made. After a successful call to enqueue an asynchronous I/O operation, the value of the file offset for the file is unspecified.

The *aiocbp->aio_lio_opcode* field shall be ignored by *aio_write*( ).

Simultaneous asynchronous operations using the same *aiocbp* produce undefined results.

SIO If synchronized I/O is enabled on the file associated with *aiocbp->aio_fildes*, the behavior of this function shall be according to the definitions of synchronized I/O data integrity completion, and synchronized I/O file integrity completion.

For any system action that changes the process memory space while an asynchronous I/O is outstanding to the address range being changed, the result of that action is undefined.

For regular files, no data transfer shall occur past the offset maximum established in the open file description associated with *aiocbp->aio_fildes*.

RETURN VALUE

The *aio_write*( ) function shall return the value zero if the I/O operation is successfully queued; 2
otherwise, the function shall return the value −1 and set *errno* to indicate the error.

ERRORS

The *aio_write*( ) function shall fail if:

[EAGAIN] The requested asynchronous I/O operation was not queued due to system resource limitations.

Each of the following conditions may be detected synchronously at the time of the call to *aio_write*( ), or asynchronously. If any of the conditions below are detected synchronously, the

aio_write( ) function shall return –1 and set *errno* to the corresponding value. If any of the conditions below are detected asynchronously, the return status of the asynchronous operation shall be set to –1, and the error status of the asynchronous operation is set to the corresponding value.

[EBADF] The *aiocbp->aio_fildes* argument is not a valid file descriptor open for writing.

[EINVAL] The file offset value implied by *aiocbp->aio_offset* would be invalid, 2
PIO *aiocbp->aio_reqprio* is not a valid value, or *aiocbp->aio_nbytes* is an invalid 2
value. 2

In the case that the *aio_write*( ) successfully queues the I/O operation, the return status of the asynchronous operation shall be one of the values normally returned by the *write*( ) function call. If the operation is successfully queued but is subsequently canceled or encounters an error, the error status for the asynchronous operation contains one of the values normally set by the *write*( ) function call, or one of the following:

[EBADF] The *aiocbp->aio_fildes* argument is not a valid file descriptor open for writing.

[EINVAL] The file offset value implied by *aiocbp->aio_offset* would be invalid.

[ECANCELED] The requested I/O was canceled before the I/O completed due to an explicit *aio_cancel*( ) request.

The following condition may be detected synchronously or asynchronously:

[EFBIG] The file is a regular file, *aiobcp->aio_nbytes* is greater than 0, and the starting offset in *aiobcp->aio_offset* is at or beyond the offset maximum in the open file description associated with *aiocbp->aio_fildes*.

EXAMPLES

None.

APPLICATION USAGE

The *aio_write*( ) function is part of the Asynchronous Input and Output option and need not be available on all implementations.

RATIONALE

None.

FUTURE DIRECTIONS

None.

SEE ALSO

aio_cancel( ), *aio_error*( ), *aio_read*( ), *aio_return*( ), *close*( ), *exec*, *exit*( ), *fork*( ), *lio_listio*( ), *lseek*( ), *write*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

CHANGE HISTORY

First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

Large File Summit extensions are added.

Issue 6

The [ENOSYS] error condition has been removed as stubs need not be provided if an implementation does not support the Asynchronous Input and Output option.

The APPLICATION USAGE section is added.

The following new requirements on POSIX implementations derive from alignment with the Single UNIX Specification:

- In the DESCRIPTION, text is added to indicate that for regular files no data transfer occurs past the offset maximum established in the open file description associated with *aiocbp->aio_fildes*.
- The [EFBIG] error is added as part of the large file support extensions.

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/14 is applied, rewording the DESCRIPTION when prioritized I/O is supported to account for threads, and removing the words ‘‘to the calling process’’ in the RETURN VALUE section. 2

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/15 is applied, updating the [EINVAL] error, so that detection of an [EINVAL] error for an invalid value of *aiocbp->aio_reqprio* is only required if the Prioritized Input and Output option is supported. 2

NAME

lio_listio — list directed I/O (**REALTIME**)

SYNOPSIS

AIO

```
#include <aio.h>

int lio_listio(int mode, struct aiocb *restrict const list[restrict],
    int nent, struct sigevent *restrict sig);
```

DESCRIPTION

The *lio_listio*( ) function shall initiate a list of I/O requests with a single function call.

The *mode* argument takes one of the values LIO_WAIT or LIO_NOWAIT declared in **<aio.h>** and determines whether the function returns when the I/O operations have been completed, or as soon as the operations have been queued. If the *mode* argument is LIO_WAIT, the function shall wait until all I/O is complete and the *sig* argument shall be ignored.

If the *mode* argument is LIO_NOWAIT, the function shall return immediately, and asynchronous notification shall occur, according to the *sig* argument, when all the I/O operations complete. If *sig* is NULL, then no asynchronous notification shall occur. If *sig* is not NULL, asynchronous notification occurs as specified in Section 2.4.1 (on page 28) when all the requests in *list* have completed.

The I/O requests enumerated by *list* are submitted in an unspecified order.

The *list* argument is an array of pointers to **aiocb** structures. The array contains *nent* elements. The array may contain NULL elements, which shall be ignored.

If the buffer pointed to by *list* or the **aiocb** structures pointed to by the elements of the array *list* become illegal addresses before all asynchronous I/O completed and, if necessary, the notification is sent, then the behavior is undefined. If the buffers pointed to by the *aio_buf* member of the **aiocb** structure pointed to by the elements of the array *list* become illegal addresses prior to the asynchronous I/O associated with that **aiocb** structure being completed, the behavior is undefined. 2

The *aio_lio_opcode* field of each **aiocb** structure specifies the operation to be performed. The supported operations are LIO_READ, LIO_WRITE, and LIO_NOP; these symbols are defined in **<aio.h>**. The LIO_NOP operation causes the list entry to be ignored. If the *aio_lio_opcode* element is equal to LIO_READ, then an I/O operation is submitted as if by a call to *aio_read*( ) with the *aiocbp* equal to the address of the **aiocb** structure. If the *aio_lio_opcode* element is equal to LIO_WRITE, then an I/O operation is submitted as if by a call to *aio_write*( ) with the *aiocbp* equal to the address of the **aiocb** structure.

The *aio_fildes* member specifies the file descriptor on which the operation is to be performed.

The *aio_buf* member specifies the address of the buffer to or from which the data is transferred.

The *aio_nbytes* member specifies the number of bytes of data to be transferred.

The members of the **aiocb** structure further describe the I/O operation to be performed, in a manner identical to that of the corresponding **aiocb** structure when used by the *aio_read*( ) and *aio_write*( ) functions.

The *nent* argument specifies how many elements are members of the list; that is, the length of the array.

The behavior of this function is altered according to the definitions of synchronized I/O data integrity completion and synchronized I/O file integrity completion if synchronized I/O is enabled on the file associated with *aio_fildes*.

For regular files, no data transfer shall occur past the offset maximum established in the open file description associated with *aiocbp->aio_fildes*.

If *sig->sigev_notify* is SIGEV_THREAD and *sig->sigev_notify_attributes* is a non-NULL pointer and the block pointed to by this pointer becomes an illegal address prior to all asynchronous I/O being completed, then the behavior is undefined. 2 2 2

RETURN VALUE

If the *mode* argument has the value LIO_NOWAIT, the *lio_listio*( ) function shall return the value zero if the I/O operations are successfully queued; otherwise, the function shall return the value –1 and set *errno* to indicate the error.

If the *mode* argument has the value LIO_WAIT, the *lio_listio*( ) function shall return the value zero when all the indicated I/O has completed successfully. Otherwise, *lio_listio*( ) shall return a value of –1 and set *errno* to indicate the error.

In either case, the return value only indicates the success or failure of the *lio_listio*( ) call itself, not the status of the individual I/O requests. In some cases one or more of the I/O requests contained in the list may fail. Failure of an individual request does not prevent completion of any other individual request. To determine the outcome of each I/O request, the application shall examine the error status associated with each **aiocb** control block. The error statuses so returned are identical to those returned as the result of an *aio_read*( ) or *aio_write*( ) function.

ERRORS

The *lio_listio*( ) function shall fail if:

[EAGAIN] The resources necessary to queue all the I/O requests were not available. The application may check the error status for each **aiocb** to determine the individual request(s) that failed.

[EAGAIN] The number of entries indicated by *nent* would cause the system-wide limit {AIO_MAX} to be exceeded.

[EINVAL] The *mode* argument is not a proper value, or the value of *nent* was greater than {AIO_LISTIO_MAX}.

[EINTR] A signal was delivered while waiting for all I/O requests to complete during an LIO_WAIT operation. Note that, since each I/O operation invoked by *lio_listio*( ) may possibly provoke a signal when it completes, this error return may be caused by the completion of one (or more) of the very I/O operations being awaited. Outstanding I/O requests are not canceled, and the application shall examine each list element to determine whether the request was initiated, canceled, or completed.

[EIO] One or more of the individual I/O operations failed. The application may check the error status for each **aiocb** structure to determine the individual request(s) that failed.

In addition to the errors returned by the *lio_listio*( ) function, if the *lio_listio*( ) function succeeds or fails with errors of [EAGAIN], [EINTR], or [EIO], then some of the I/O specified by the list may have been initiated. If the *lio_listio*( ) function fails with an error code other than [EAGAIN], [EINTR], or [EIO], no operations from the list shall have been initiated. The I/O operation indicated by each list element can encounter errors specific to the individual read or write function being performed. In this event, the error status for each **aiocb** control block contains the associated error code. The error codes that can be set are the same as would be set by a *read*( ) or *write*( ) function, with the following additional error codes possible:

23122 [EAGAIN] The requested I/O operation was not queued due to resource limitations.

23123 [ECANCELED] The requested I/O was canceled before the I/O completed due to an explicit
23124 *aio_cancel*( ) request.

23125 [EFBIG] The *aiocbp->aio_lio_opcode* is LIO_WRITE, the file is a regular file,
23126 *aiocbp->aio_nbytes* is greater than 0, and the *aiocbp->aio_offset* is greater than or
23127 equal to the offset maximum in the open file description associated with
23128 *aiocbp->aio_fildes*.

23129 [EINPROGRESS] The requested I/O is in progress.

23130 [EOVERFLOW] The *aiocbp->aio_lio_opcode* is LIO_READ, the file is a regular file,
23131 *aiocbp->aio_nbytes* is greater than 0, and the *aiocbp->aio_offset* is before the
23132 end-of-file and is greater than or equal to the offset maximum in the open file
23133 description associated with *aiocbp->aio_fildes*.

23134 **EXAMPLES**

23135 None.

23136 **APPLICATION USAGE**

23137 None.

23138 **RATIONALE**

23139 Although it may appear that there are inconsistencies in the specified circumstances for error
23140 codes, the [EIO] error condition applies when any circumstance relating to an individual
23141 operation makes that operation fail. This might be due to a badly formulated request (for
23142 example, the *aio_lio_opcode* field is invalid, and *aio_error*( ) returns [EINVAL]) or might arise from
23143 application behavior (for example, the file descriptor is closed before the operation is initiated,
23144 and *aio_error*( ) returns [EBADF]).

23145 The limitation on the set of error codes returned when operations from the list shall have been
23146 initiated enables applications to know when operations have been started and whether
23147 *aio_error*( ) is valid for a specific operation.

23148 **FUTURE DIRECTIONS**

23149 None.

23150 **SEE ALSO**

23151 *aio_read*( ), *aio_write*( ), *aio_error*( ), *aio_return*( ), *aio_cancel*( ), *close*( ), *exec*, *exit*( ), *fork*( ), *lseek*( ),
23152 *read*( ), the Base Definitions volume of IEEE Std 1003.1-2001, **<aio.h>**

23153 **CHANGE HISTORY**

23154 First released in Issue 5. Included for alignment with the POSIX Realtime Extension.

23155 Large File Summit extensions are added.

23156 **Issue 6**

23157 The [ENOSYS] error condition has been removed as stubs need not be provided if an
23158 implementation does not support the Asynchronous Input and Output option.

23159 The *lio_listio*( ) function is marked as part of the Asynchronous Input and Output option.

23160 The following new requirements on POSIX implementations derive from alignment with the
23161 Single UNIX Specification:

23162 • In the DESCRIPTION, text is added to indicate that for regular files no data transfer occurs
23163 past the offset maximum established in the open file description associated with
23164 *aiocbp->aio_fildes*. This change is to support large files.

- The [EBIG] and [EOVERFLOW] error conditions are defined. This change is to support large files.

The DESCRIPTION is updated to avoid use of the term ‘‘must’’ for application requirements.

The **restrict** keyword is added to the *lio_listio*( ) prototype for alignment with the ISO/IEC 9899:1999 standard.

Issue 6

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/53 is applied, adding new text for symmetry with the *aio_read*( ) and *aio_write*( ) functions to the DESCRIPTION.

IEEE Std 1003.1-2001/Cor 2-2004, item XSH/TC2/D6/54 is applied, adding text to the DESCRIPTION making it explicit that the user is required to keep the structure pointed to by *sig->sigev_notify_attributes* valid until the last asynchronous operation finished and the notification has been sent.